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Lumber and Plywood

Used in the Construction of Nonresidential and Nonhousekeeping Buildings in the United States, by Regions, 1969

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Research Paper WO-24

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PREFACE

This report presents estimates of the amount of lumber and plywood used in nonresidential and nonhousekeeping building construction in the United States during 1969. Consumption of these materials is shown by building type (nonhousekeeping, industrial, commercial, religious, educational, hospital, and other), by structural class (wood, steel/masonry, and concrete), and by region (North, South, and West). Factors of wood use are shown per 100 square feet of floor area and per $1,000 of construction cost.

This is one of a series of studies on wood use conducted under the provisions of the McSweeney-McNary Forest Research Act of 1928, as amended, which authorized and directed the Secretary of Agriculture to cooperate with State and other agencies "in making and keeping current a comprehensive survey of present and prospective requirements for timber and other forest products."

Acknowledgment is made to the more than 1,700 architects and contractors who provided building project information consisting of construction cost data and estimates of the amount of wood materials required for the forming of concrete and other facilitating purposes. Within the Forest Service, special appreciation is expressed to Harry Kevich and staff, Architectural Branch, Division of Engineering, Region 5, for performing materials takeoff from plans and specifications of buildings in the West Region, and to David Neebe, Joseph Morsch, and David McKeever for developing computer programs used for data analysis and computation.

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Nonresidential and nonhousekeeping building construction in the United States during 1969 amounted to 1.6 billion square feet of floor area with a construction value of $32.7 billion. Lumber used in this construction totaled more than 1.6 billion board feet; plywood, 974 million square feet (3/8-inch basis).

The building projects on which this study was based were classified into seven building types and three structural classes, and the amounts of lumber and plywood used were determined for three regions—North, South, and West.

CONTENTS

Page

Introduction 1

Characteristics of buildings 2

  Floor area 2

  Construction value 4

  Value of construction per square foot of floor area 6

Wood used in building construction 8

  Lumber 8

    Use per unit of measure 8

    Total lumber use 10

  Plywood 12

    Use per unit of measure 12

    Total plywood use 14

Appendix 16

  Definitions 16

  Survey procedure 17

    Measurement of construction activity 17

    Measurement of wood use 17

Lumber and Plywood Used in the Construction of Nonresidential and Nonhousekeeping Buildings in the United States, by Regions, 1969

by

William H. Reid and Maurice G. Wright[1]

INTRODUCTION

Nonresidential and nonhousekeeping building construction in the United States during 1969 amounted to 1.6 billion square feet of floor area with a construction value of $32.7 billion. Lumber used in this construction totaled more than 1.6 billion board feet; plywood, 974 million square feet (3/8-inch basis).

The building projects on which this study was based were classified into seven building types and three structural classes, and the amount of lumber and plywood used were determined for three regions (fig. 1).

The North Region contained about three-fifths of the total floor area constructed and the total construction value, but almost half of the lumber and plywood used was in the West. A breakdown of quantities used among the seven building types indicated that more than a fourth of all the lumber and plywood went into commercial building construction.

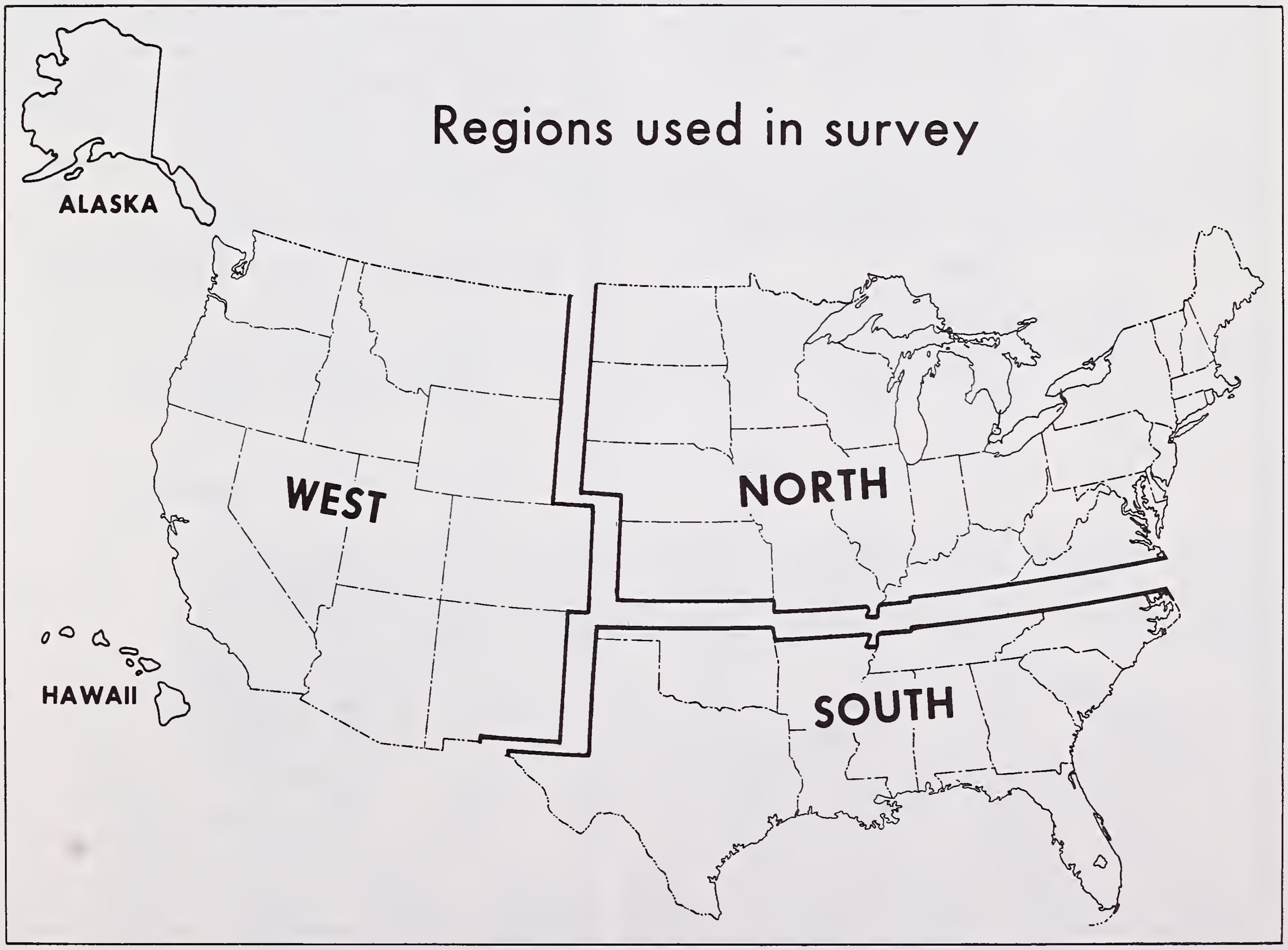

Figure 1

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[1] Forest Economics and Marketing Research, USDA Forest Service.

CHARACTERISTICS OF BUILDINGS

The characteristics of nonresidential and nonhousekeeping buildings constructed in 1969 are described by floor area, value of construction, building type, structural class, and region.[2] These characteristics are important in determing the requirements for lumber and plywood in building construction. Both floor area and value of construction are measurements of construction activity and are available from public and private sources.

The seven building types—nonhousekeeping, industrial, commercial, religious, educational, hospital, and other—vary in lumber and plywood requirements. This is due to amount of construction activity among building types, differences in uses of buildings, building code requirements, and preferences of individuals specifying structural materials.

The three structural classes—wood, steel/masonry, and concrete—grouped those buildings having comparable material requirements. This grouping was designed to reduce wide differences in lumber and plywood usage within each class.

Three regions—North, South, and West—were designated in order to measure differences in regional usage of lumber and plywood.

FLOOR AREA

Of the 1.6 billion square feet of floor area contained in nonhousekeeping and nonresidential buildings, one-third was in industrial buildings, almost a third in commercial, and the balance in the five remaining building types (table 1, fig. 2). Floor area among these five ranged from 15 percent in educational buildings to 3 percent in religious.

Nearly three-fourths of the total floor area was contained in buildings in the steel/masonry structural class. The remaining floor area was almost equally divided between the wood and concrete classes (fig. 3). Industrial and commercial buildings together accounted for over three-fifths of the total floor area in each of the wood and steel/masonry classes. In the concrete class almost one-fourth of the floor area was in commercial

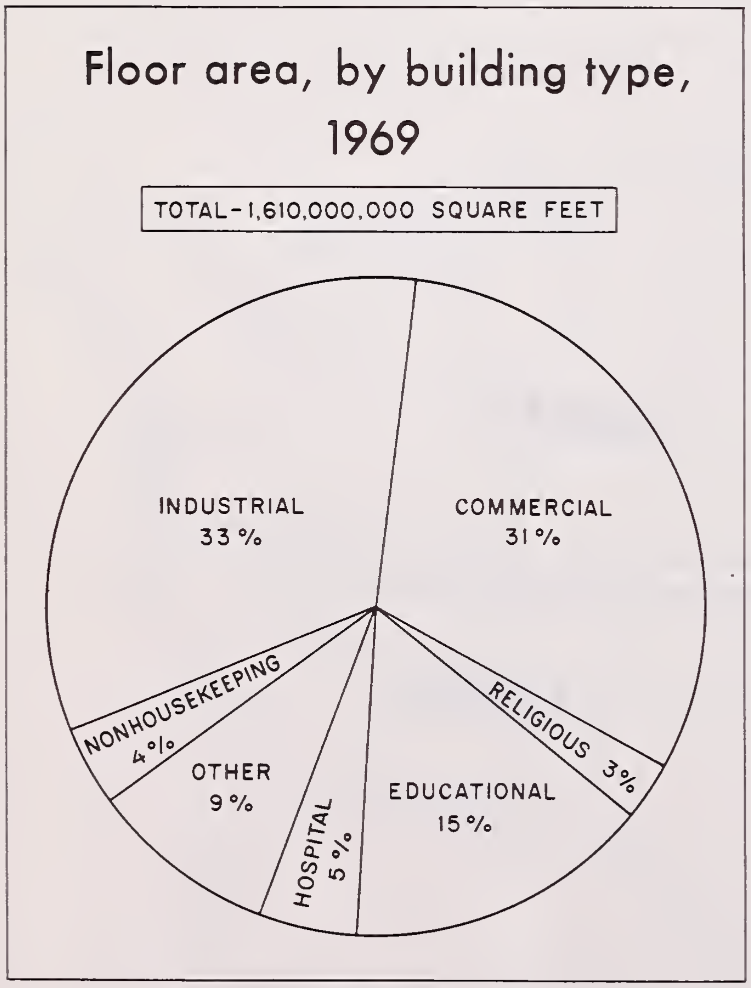

Figure 2

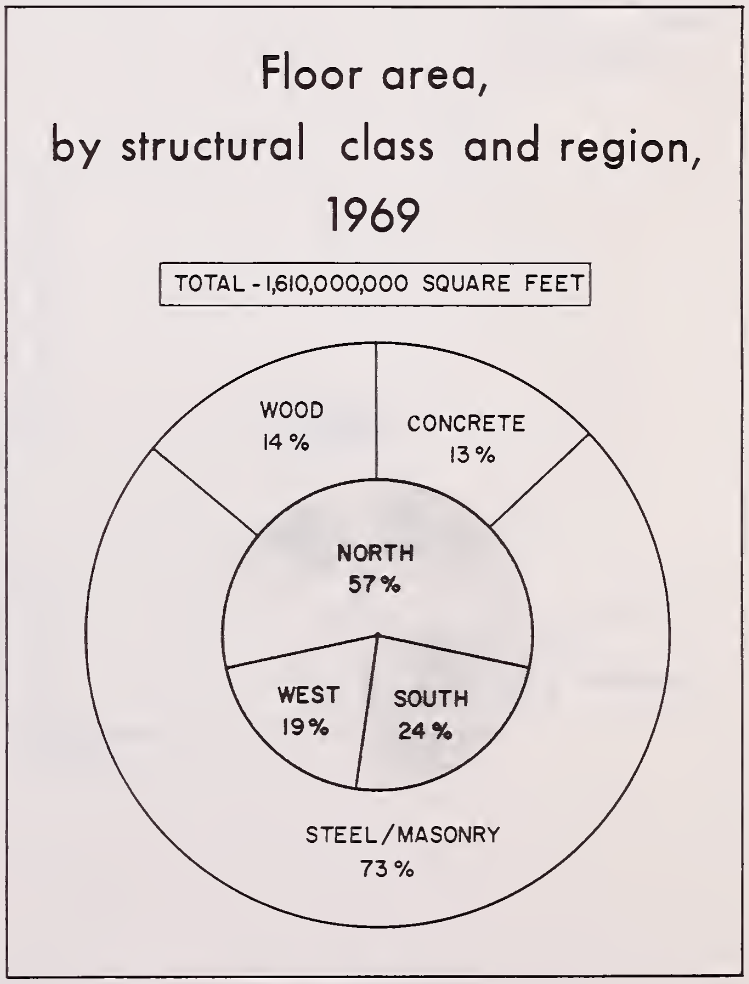

Figure 3

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[2] See definitions in Appendix.

Table 1.-Floor area of new construction put in place in the United States, by building type, region, and structural class, 1969

Building type and region	All classes		Structural class		
			Wood	Steel/masonry	Concrete
	Hundred sq. ft.	Percent	Hundred sq. ft.	Hundred sq. ft.	Hundred sq. ft.
Nonhousekeeping					
North	287,920	49	39,610	123,074	125,236
South	154,580	26	21,487	65,387	67,706
West	147,500	25	77,880	45,430	24,190
Total	590,000	100	138,977	233,891	217,132
Industrial					
North	3,058,100	58	20,517	2,998,990	38,593
South	1,335,600	25	150,000	1,068,067	117,533
West	906,300	17	515,685	375,615	15,000
Total	5,300,000	100	686,201	4,442,672	171,126
Commercial					
North	2,707,650	55	188,030	2,380,127	139,493
South	1,207,800	24	65,221	984,357	158,222
West	1,034,550	21	428,153	431,558	174,839
Total	4,950,000	100	681,404	3,796,043	472,553
Religious					
North	257,840	59	150,626	96,965	10,249
South	117,920	27	74,761	37,027	6,132
West	64,240	14	52,484	3,726	8,030
Total	440,000	100	277,871	137,718	24,411
Educational					
North	1,593,150	65	19,465	1,280,478	293,207
South	496,470	20	14,398	367,884	114,188
West	380,380	15	101,181	223,283	55,916
Total	2,470,000	100	135,044	1,871,645	463,310
Hospital					
North	401,720	48	29,234	177,442	195,044
South	231,570	28	19,220	72,482	139,868
West	196,710	24	87,143	52,915	56,652
Total	830,000	100	135,597	302,839	391,564
Other					
North	804,080	53	70,422	590,341	143,317
South	375,440	25	49,558	232,773	93,109
West	340,480	22	83,418	133,808	123,254
Total	1,520,000	100	203,398	956,922	359,680
All buildings					
North	9,110,460	57	517,904	7,647,417	945,139
South	3,919,380	24	394,645	2,827,977	696,758
West	3,070,160	19	1,345,944	1,266,335	457,881
Total	16,100,000	100	2,258,493	11,741,729	2,099,778

Note: Data may not add to totals because of rounding.

Source: Derived from a special report prepared by F. W. Dodge Division, McGraw-Hill Information Systems Company New York, N. Y., for the Forest Service, USDA, under contract 13-407, U. S. Department of Commerce, "Statistical Abstract of the United States, 1971, table 1096 "Construction Contracts"; and "Construction Review, December 1971," Table 1-A.

buildings, followed fairly closely by educational, hospital, and other buildings.

Some 57 percent of the total floor area was in the North and nearly one-third of that was in industrial buildings of the steel/masonry class. Of the 24 percent in the South, one-third was in industrial buildings and nearly one-third in commercial buildings. One-third of the 29 percent of total floor area located in the West was in commercial buildings and nearly as much in industrial.

Almost three-fifths of the floor area of buildings in the wood structural class was in the West, two-thirds of the floor area of the steel/masonry class was in the North, and almost half of the area in the concrete class was in the North.

CONSTRUCTION VALUE

In 1969 the amount of building construction as measured by value of construction put in place was more than $32.7 billion (table 2, fig. 4). Almost three-fourths of this value was in commercial, industrial, and educational buildings, one-fifth in hospitals and other, and the remainder in religious and nonhousekeeping buildings.

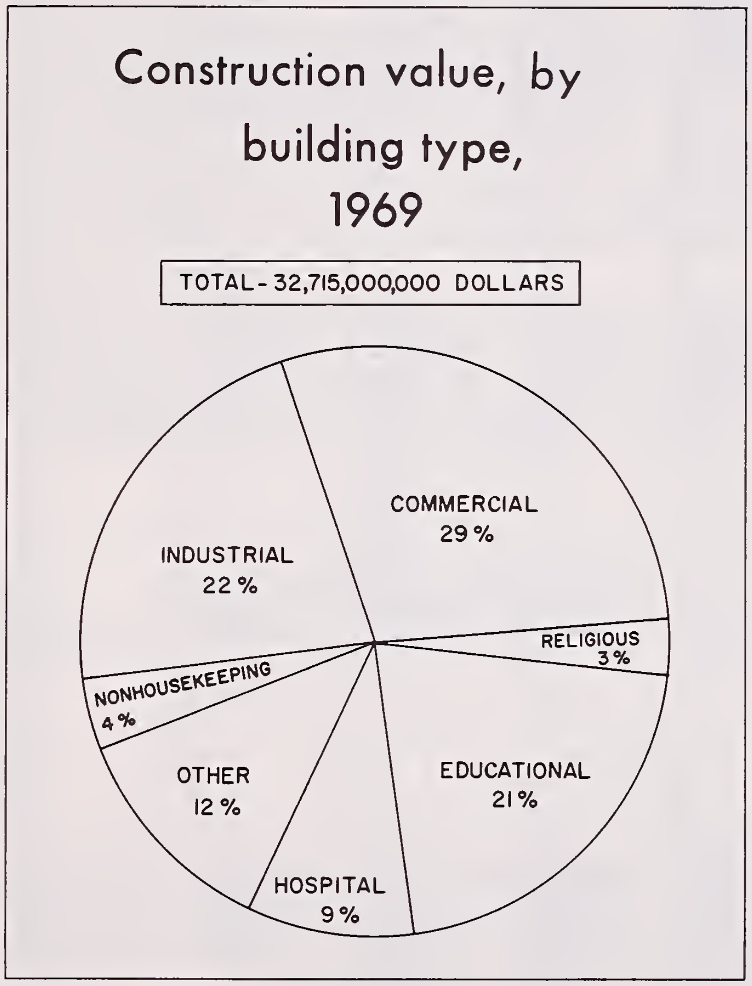

Figure 4

About 69 percent of the value of construction was in buildings in the steel/masonry structural class, 19 percent in the concrete, and 12 percent in the wood (fig. 5). Three-fifths of the value of buildings in the steel/masonry class and over half of the value of those in the wood class were in industrial and commercial buildings. Three-fifths of the value of religious buildings was in the wood structural class, while almost three-fifths of the value of hospitals was in the concrete class.

The North contained 62 percent of the total value of buildings constructed; the South, 20 percent; and the West, 18 percent. Regional distribution by structural classes, however, differed considerably from these percentages. For instance, 70 percent of the value of the steel masonry class was in the North compared to 11 percent in the West. About 30 percent of the value in the wood structural class was in the North, 15 percent in the South, and 55 percent in the West. For the concrete structural class, distribution was 54 percent North, 27 South, and 19 West.

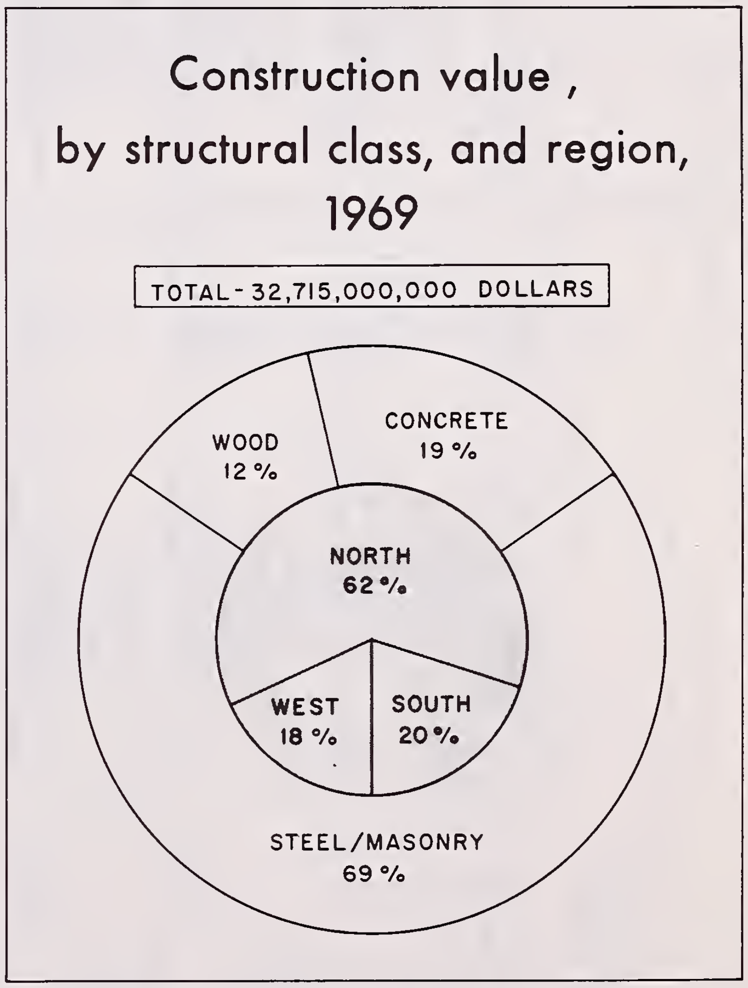

Figure 5

Table 2.-Value of new construction put in place in the United States, by building type, structural class, and region, 1969

Building type and region	All classes		Structural class		
			Wood	Steel/masonry	Concrete
	Thousand dollars	Percent	Thousand dollars	Thousand dollars	Thousand dollars
Nonhousekeeping					
North	775,251	56	108,083	284,867	382,301
South	318,087	23	27,992	140,276	149,819
West	283,662	21	121,124	102,969	59,569
Total	1,377,000	100	257,198	528,112	591,689
Industrial					
North	4,219,978	58	23,539	4,111,850	84,589
South	1,730,337	24	198,989	1,294,292	237,056
West	1,350,685	18	680,745	649,679	20,260
Total	7,301,000	100	903,273	6,055,821	341,906
Commercial					
North	6,016,640	64	371,967	5,208,419	436,255
South	1,635,774	17	104,690	1,310,255	220,829
West	1,748,586	19	578,782	730,909	438,895
Total	9,401,000	100	1,055,438	7,249,583	1,095,979
Religious					
North	654,056	66	334,093	297,876	22,087
South	220,324	22	134,177	72,927	13,219
West	113,620	12	93,168	5,567	14,884
Total	988,000	100	561,439	376,371	50,190
Educational					
North	4,786,518	69	46,970	3,695,699	1,043,849
South	1,110,417	16	27,760	780,623	302,033
West	1,000,065	15	270,018	587,038	143,009
Total	6,897,000	100	344,748	5,063,361	1,488,891
Hospital					
North	1,596,501	54	72,855	590,930	932,716
South	767,034	26	32,215	217,838	516,981
West	609,465	20	209,656	161,508	238,301
Total	2,973,000	100	314,726	970,276	1,687,998
Other					
North	2,312,136	61	154,437	1,648,518	509,181
South	748,044	20	68,072	414,416	265,556
West	717,820	19	152,178	324,455	241,188
Total	3,778,000	100	374,687	2,387,389	1,015,924
All buildings					
North	20,361,080	62	1,111,944	15,838,159	3,410,978
South	6,530,017	20	593,895	4,230,627	1,705,493
West	5,823,903	18	2,105,671	2,562,125	1,156,106
Total	32,715,000	100	3,811,510	22,630,911	6,272,577

Source: Derived from U. S. Dept. of Commerce, Bureau of Census, Construction Review, Dec. 1971, Table 1-A, and from a special report prepared by F. W. Dodge Division, McGraw-Hill Information Systems, New York, N. Y., for the Forest Service, USDA, under contract 13-407.

Note: Data may not add to totals because of rounding.

VALUE OF CONSTRUCTION PER SQUARE FOOT OF FLOOR AREA

The values of construction per square foot of floor area (table 3) were derived by dividing the values of new construction put in place (table 2) by floor areas of new construction put in place (table 1).

The value of construction for all building types, regions, and structural classes averaged $20.32 per square foot of floor area (fig. 6). Hospitals had the highest value ($35.82) per square foot, and industrial buildings the lowest ($13.78). The value of construction per square foot of floor area was highest in the North and lowest in the South. Buildings classified in the concrete structural class had the highest value ($29.87) per square foot of floor area, and buildings in the wood structural class the lowest ($16.88).

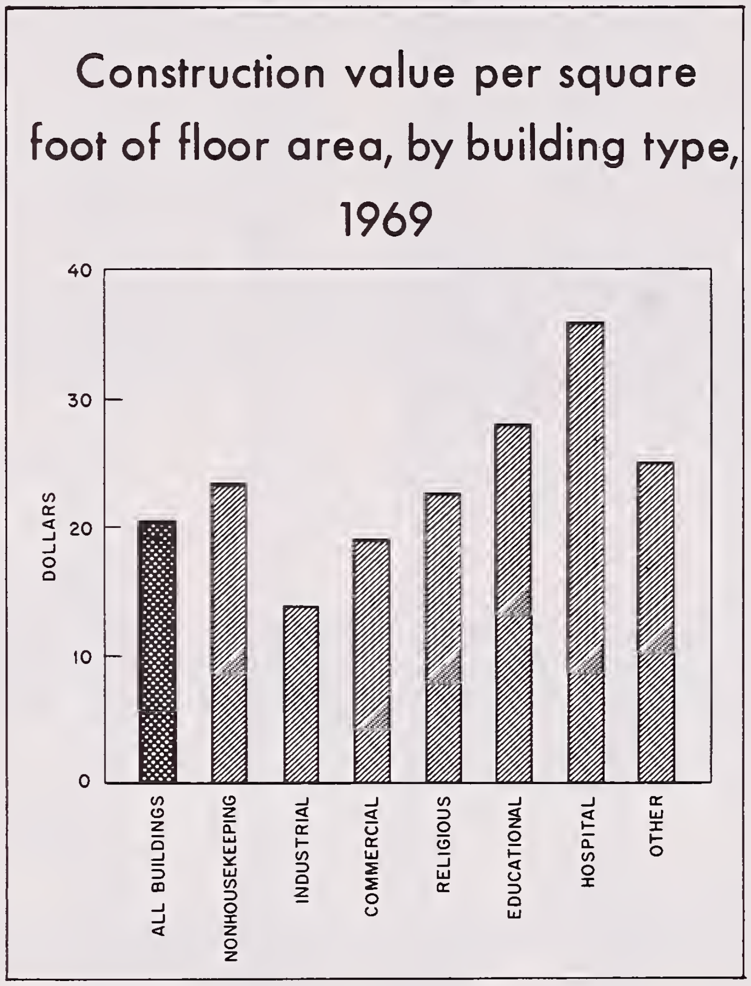
Construction value per square foot of floor area, by building type, 1969

Figure 6

Table 3.- Construction value per square foot of floor area by building type, region, and structural class, 1969
(Dollars)

Building type and region	All classes	Structural class		
		Wood	Steel/masonry	Concrete
Nonhousekeeping				
North	26.93	27.29	23.15	30.53
South	20.58	13.03	21.45	22.13
West	19.23	15.55	22.67	24.63
Total	23.34	18.51	22.58	27.25
Industrial				
North	13.80	11.47	13.71	21.92
South	12.96	13.27	12.12	20.17
West	14.90	13.20	17.30	13.51
Total	13.78	13.16	13.63	19.98
Commercial				
North	22.22	19.78	21.88	31.27
South	13.54	16.05	13.31	13.96
West	16.90	13.52	16.94	25.10
Total	18.99	15.49	19.10	23.19
Religious				
North	25.37	22.18	30.72	21.55
South	18.68	17.95	19.70	21.56
West	17.69	17.75	14.94	18.54
Total	22.45	20.20	27.33	20.56
Educational				
North	30.04	24.13	28.86	35.60
South	22.37	19.28	21.22	26.45
West	26.29	26.69	26.29	25.58
Total	27.92	25.53	27.05	32.14
Hospital				
North	39.74	24.92	33.30	47.82
South	33.12	16.76	30.05	36.96
West	30.99	24.06	30.52	42.06
Total	35.82	23.21	32.04	43.11
Other				
North	28.76	21.93	27.92	35.53
South	19.92	13.74	17.80	28.52
West	21.08	18.24	24.25	19.57
Total	24.86	18.42	24.95	28.24
All buildings				
North	22.35	21.47	20.71	36.09
South	16.66	15.05	14.96	24.48
West	18.97	15.64	20.23	25.25
Total	20.32	16.88	19.27	29.87

WOOD USED IN BUILDING CONSTRUCTION

Lumber and plywood use factors were derived from a sample of building projects stratified by building type, region, and structural class. Regression equations of wood use based on floor area and construction value were developed for each stratum. These equations were applied to a stratified sample of building projects, where floor area and value were known, to derive factors of wood use per unit of measure. These factors were applied to stratified estimates of floor area and value of new construction, to determine total lumber and plywood used.

LUMBER[3]

Use Per Unit of Measure

The quantity of lumber used in all building construction averaged 102 board feet per 100 square feet of floor area (table 4). Usage by building type, however, ranged from 71 board feet in industrial to 351 board feet in religious buildings. Regional use of lumber for all buildings ranged from 55 board feet in the North to 258 board feet in the West (fig. 7). Among the structural classes, the wood class usage was more than seven times the amount used in the steel/masonry class and almost five times that used in the concrete class.

Use of lumber per $1,000 of construction value averaged 50 board feet for all buildings (table 4). Usage by building type ranged from 39 board feet in educational to 156 board feet in religious buildings. In the West lumber use per $1,000 of construction value was more than five times that in the North and over twice that in the South (fig. 8). Over eight times as much lumber was used per $1,000 of construction value in the wood structural class as was used in either the steel/masonry or the concrete class.

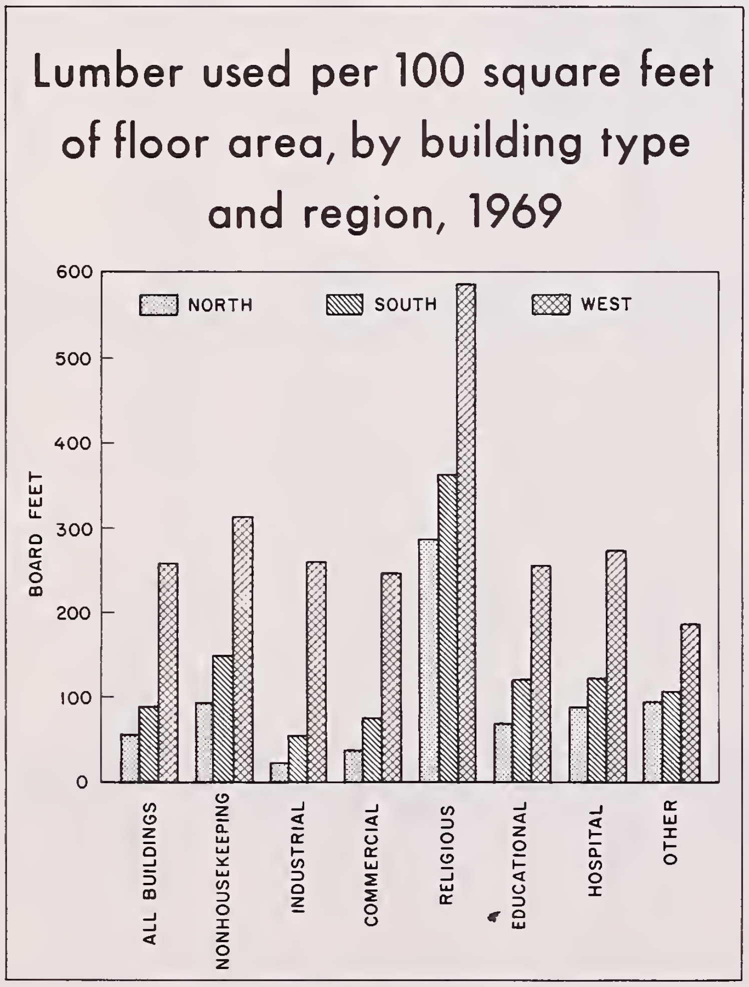

Figure 7

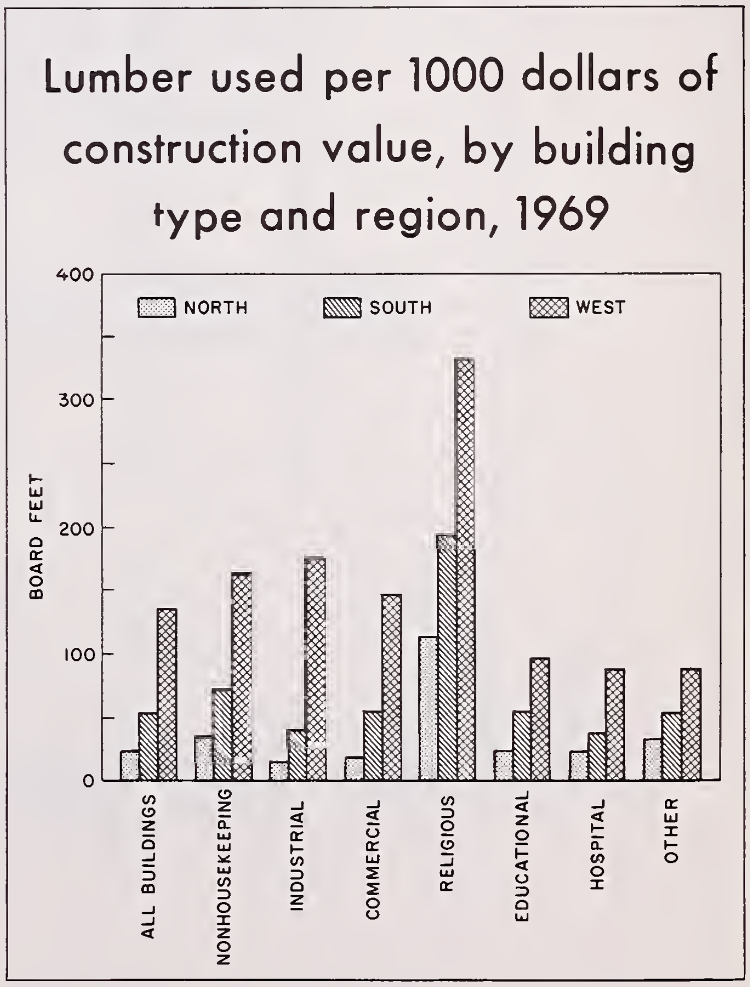

Figure 8

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[3] Includes glued-laminated lumber.

Table 4.-Lumber used per 100 square feet of floor area and per $1,000 of construction value in building construction in the United States by building type, region, and structural class, 1969
(Board feet)

Building type and region	All classes		Structural classes					
			Wood		Steel/masonry		Concrete	
	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value
Nonhousekeeping								
North	95.32	35.40	246.15	90.21	59.69	25.79	82.63	27.07
South	149.80	72.80	379.10	291.00	84.93	39.59	139.67	63.12
West	311.18	161.81	513.92	330.44	92.09	40.63	69.89	28.38
Total	163.56	70.08	416.76	225.20	73.04	32.35	99.00	36.33
Industrial								
North	22.28	16.15	105.10	91.61	21.42	15.62	45.46	20.74
South	53.29	41.14	199.11	150.09	33.81	27.90	44.25	21.94
West	261.27	175.31	389.58	295.12	94.09	54.40	36.60	27.10
Total	70.96	51.51	339.44	257.87	30.54	22.40	43.85	21.95
Commercial								
North	38.70	17.42	162.38	82.08	28.47	13.01	46.60	14.90
South	73.07	53.95	337.74	210.41	58.58	44.01	54.13	38.78
West	247.65	146.52	402.62	297.84	161.12	95.13	81.76	32.57
Total	90.76	47.79	330.12	213.13	51.36	26.89	62.13	26.79
Religious								
North	287.99	113.53	432.38	194.94	87.77	28.57	60.26	27.96
South	360.51	192.95	475.18	264.76	153.25	77.81	213.94	99.24
West	586.51	331.61	666.98	375.73	291.83	195.32	197.29	106.44
Total	351.01	156.32	488.21	241.63	110.89	40.58	143.94	70.01
Educational								
North	70.24	23.38	420.55	174.28	63.67	22.06	75.69	21.26
South	120.24	53.76	433.98	225.08	112.97	53.24	104.11	39.36
West	255.21	97.07	565.25	211.81	148.83	56.61	118.98	46.52
Total	108.78	38.96	530.40	207.77	83.52	30.87	87.92	27.36
Hospital								
North	89.54	22.53	386.28	155.00	59.18	17.77	72.69	15.20
South	120.78	36.46	400.00	238.65	57.13	19.01	115.40	31.22
West	275.25	88.84	471.19	195.85	55.00	18.02	179.57	42.69
Total	142.27	39.72	442.79	190.77	57.96	18.09	103.41	23.99
Other								
North	96.87	33.69	459.72	209.63	59.28	21.23	73.40	20.66
South	105.59	52.99	198.15	144.26	83.94	47.15	110.43	38.72
West	186.68	88.55	467.44	256.23	115.15	47.49	74.32	37.98
Total	119.14	47.93	399.15	216.68	73.09	29.30	83.30	29.49
All buildings								
North	54.93	24.58	307.82	143.37	35.94	17.36	69.95	19.38
South	89.91	53.97	302.35	200.91	60.20	40.24	90.19	36.85
West	257.76	135.88	435.06	278.09	127.69	63.11	96.32	38.15
Total	102.12	50.26	382.69	226.76	51.68	26.81	82.42	27.59

Total Lumber Use

Total lumber use in 1969 amounted to over 1.6 billion board feet (table 5, fig. 9). Half of the lumber was used in industrial and commercial buildings. These buildings accounted for 64 percent of the floor area and 51 percent of the construction value. One-third of the lumber was used in educational, hospital, and other buildings. These buildings accounted for 29 percent of the floor area and 42 percent of the construction value. The remaining one-sixth of the lumber was used in constructing nonhousekeeping and religious buildings. These buildings, however, accounted for only 7 percent of the total floor area and total construction value.

Approximately half of the lumber was used in building projects located in the West (fig. 10); this region, however, accounted for less than 20 percent of the floor area and construction value. Almost one-third of the lumber was used in the North; this region accounted for close to 60 percent of the floor area and construction value. The South, with one-fifth of the lumber used, accounted for 24 percent of the floor area and 20 percent of the construction value.

Over half of the lumber was used in buildings in the wood structural class; this class accounted for 14 percent of the floor area and 12 percent of the construction value. More than one-third of the lumber was used in the steel/masonry class; this class, however, accounted for 73 percent of the floor area and 69 percent of the construction value. The concrete class accounted for the remaining one-tenth of the lumber used, and 13 percent of the floor area and 19 percent of the construction value.

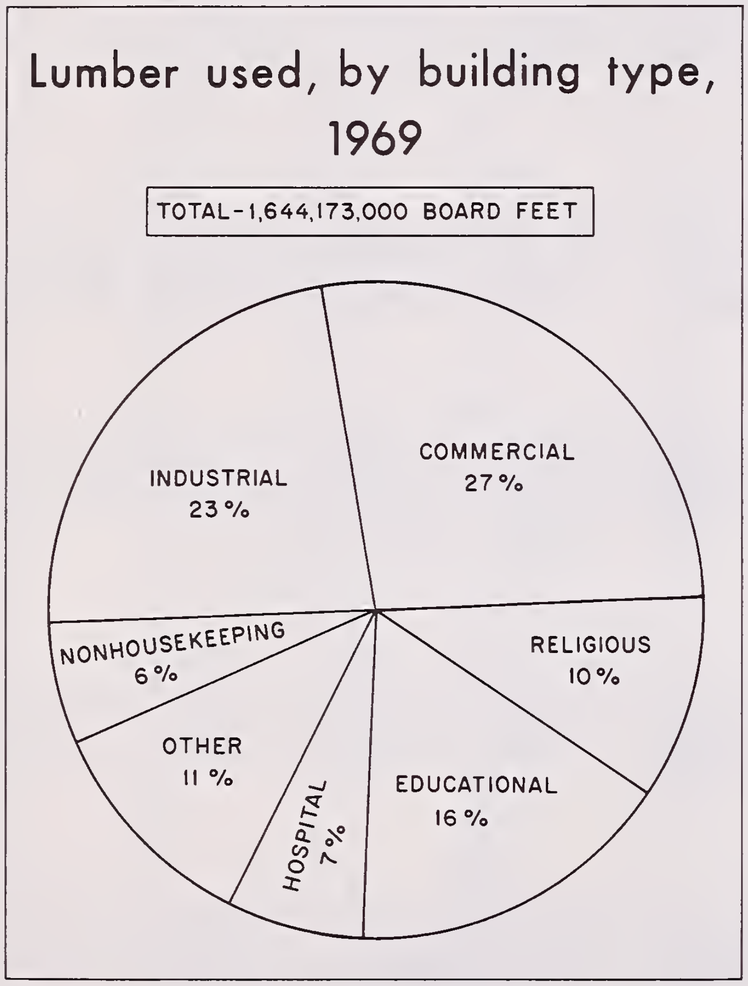

Figure 9

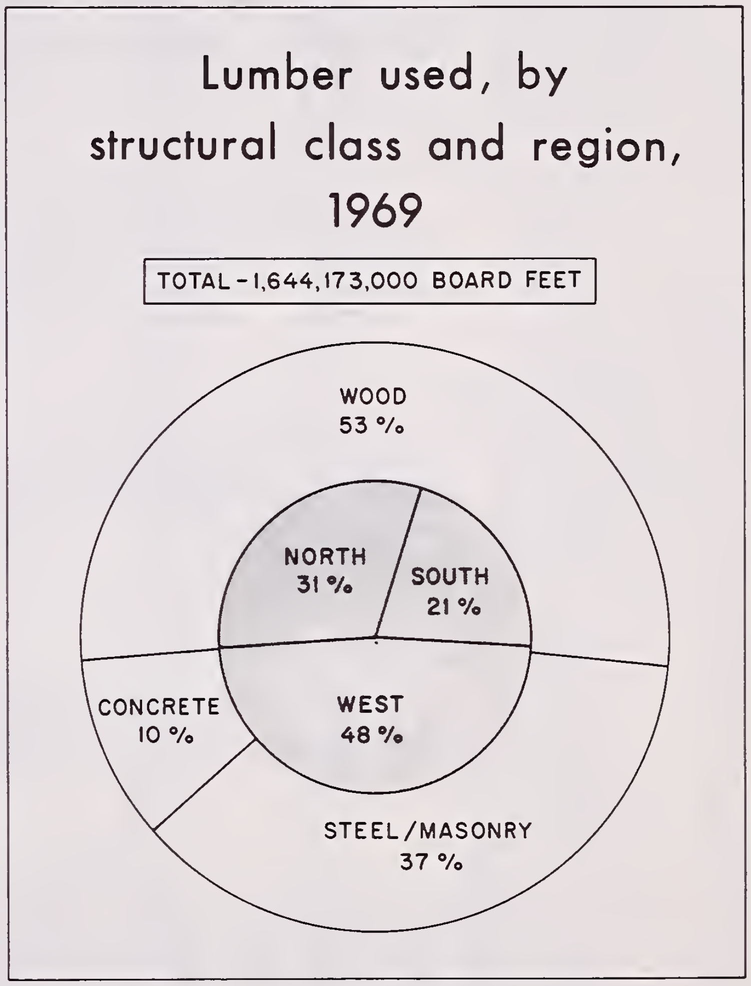

Figure 10

Table 5.-Lumber used in building construction in the United States, by building type, region, and structural class, 1969

Building type and region	All classes		Structural class		
			Wood	Steel/masonry	Concrete
	Thousand board feet	Percent	Thousand board feet	Thousand board feet	Thousand board feet
Nonhousekeeping					
North	27,446	28	9,750	7,347	10,349
South	23,156	24	8,146	5,554	9,457
West	45,898	48	40,024	4,184	1,691
Total	96,500	100	57,920	17,084	21,496
Industrial					
North	68,138	18	2,156	64,227	1,754
South	71,178	19	29,866	36,111	5,201
West	236,793	63	200,901	35,343	549
Total	376,109	100	232,924	135,680	7,504
Commercial					
North	104,794	23	30,532	67,762	6,500
South	88,256	20	22,028	57,664	8,564
West	256,211	57	172,384	69,531	14,295
Total	449,260	100	224,944	194,957	29,359
Religious					
North	74,256	48	65,128	8,510	618
South	42,511	28	35,525	5,674	1,312
West	37,678	24	35,006	1,087	1,584
Total	154,445	100	135,659	15,272	3,514
Educational					
North	111,905	42	8,186	81,527	22,192
South	59,697	22	6,248	41,560	11,888
West	97,078	36	57,193	33,232	6,653
Total	268,679	100	71,627	156,320	40,733
Hospital					
North	35,971	30	11,293	10,501	14,177
South	27,969	24	7,688	4,141	16,140
West	54,145	46	41,061	2,910	10,173
Total	118,084	100	60,042	17,552	40,490
Other					
North	77,892	43	32,375	34,998	10,520
South	39,642	22	9,820	19,540	10,282
West	63,561	35	38,993	15,408	9,160
Total	181,096	100	81,187	69,946	29,962
All buildings					
North	500,402	31	159,420	274,872	66,110
South	352,409	21	119,321	170,244	62,844
West	791,362	48	585,562	161,695	44,105
Total	1,644,173	100	864,303	606,811	173,059

Note: Data may not add to total because of rounding.

Use Per Unit of Measure

An average of 61 square feet of plywood per 100 square feet of floor area was used in all building construction (table 6). By building type, usage ranged from 31 square feet in industrial to 139 square feet in nonhousekeeping buildings. Regional use of plywood for all buildings was 35 square feet in the North, 54 square feet in the South, and 145 square feet in the West (fig. 11). This trend in usage of plywood—highest in the West and lowest in the North—was followed within building types, except nonhousekeeping where the usage in the South was less than that in the North. Among the structural classes, as was the general pattern in lumber, the wood class, with 165 square feet of plywood per 100 square feet of floor area, used much more plywood than either the steel/masonry (34 square feet) or the concrete class (96 square feet).

With the use of plywood averaging 30 square feet per $1,000 of construction value (table 6), the range of usage among building types varied from 23 square feet in industrial to 59 square feet in nonhousekeeping buildings. Regionally the range was much greater—from 16 square feet in the North to 76 in the West (fig. 12). Use of plywood per $1,000 of construction value in the wood structural class was five times that of the steel/masonry and three times that of the concrete class.

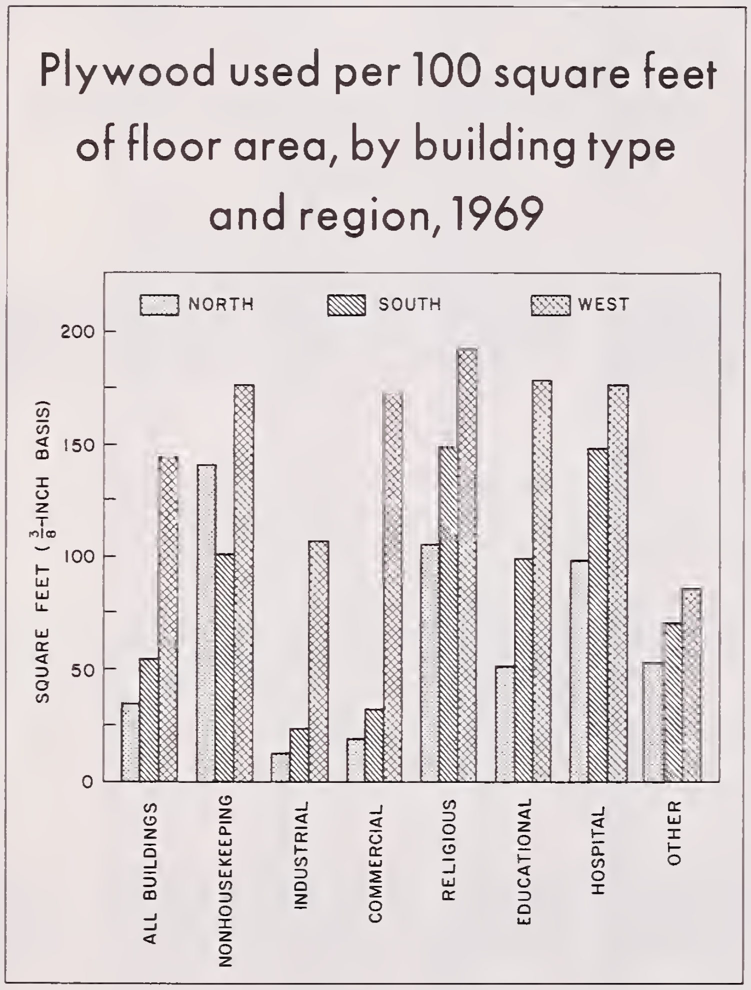

Figure 11

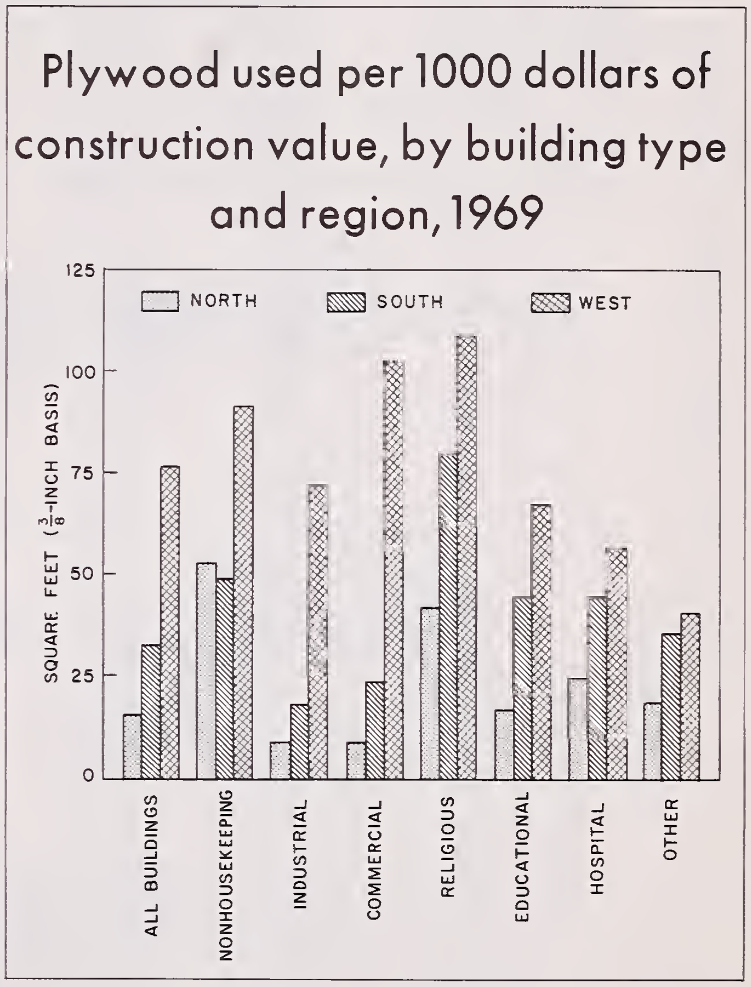

Figure 12

Table 6.-Plywood used per 100 square feet of floor area and per $1000 of construction value in building construction in the United States, by building type, region, and structural class, 1969
(Square feet, 3/8-inch basis)

Building type and region	All classes		Structural classes					
			Wood		Steel/masonry		Concrete	
	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value	Per 100 sq. ft. of floor area	Per $1,000 of construction value
Nonhousekeeping								
North	140.57	52.21	217.75	79.80	85.15	36.79	170.61	55.89
South	100.44	48.81	163.87	125.79	48.31	22.52	130.64	59.04
West	175.44	91.23	258.08	165.94	89.73	39.59	70.33	28.56
Total	138.77	59.46	232.02	125.37	75.74	33.55	146.98	53.94
Industrial								
North	12.30	8.91	42.16	36.75	11.66	8.50	46.33	21.14
South	23.14	17.86	47.93	36.13	16.63	13.72	50.68	25.13
West	106.44	71.42	155.62	117.89	42.01	24.29	28.70	21.25
Total	31.13	22.60	128.69	97.76	15.42	11.31	47.78	23.91
Commercial								
North	18.60	8.37	59.03	29.84	13.79	6.30	46.19	14.77
South	32.02	28.64	119.04	74.16	23.68	17.79	48.01	34.40
West	172.84	102.26	223.63	165.43	145.31	85.80	116.40	46.37
Total	54.11	28.49	168.20	108.59	31.30	16.39	72.78	31.38
Religious								
North	104.87	41.34	138.96	62.65	58.00	18.88	47.26	21.93
South	148.93	79.71	183.91	102.47	76.48	38.83	160.02	74.23
West	191.99	108.55	198.27	111.69	145.87	97.63	172.38	93.00
Total	129.40	57.63	162.26	80.30	65.34	23.91	116.74	56.78
Educational								
North	50.42	16.78	74.85	31.02	47.97	16.62	59.52	16.72
South	99.28	44.38	247.02	128.04	83.60	39.40	131.14	49.58
West	177.42	67.48	313.17	117.35	125.07	47.57	140.84	55.07
Total	79.80	28.58	271.77	106.45	64.17	23.72	86.99	27.07
Hospital								
North	97.52	24.54	197.18	79.12	54.52	16.37	121.70	25.45
South	147.38	44.49	177.67	106.00	98.79	32.87	168.40	45.56
West	175.54	56.66	267.37	111.13	65.35	21.41	137.21	32.62
Total	129.92	36.27	239.52	103.19	67.01	20.91	140.63	32.62
Other								
North	52.67	18.32	88.44	40.33	40.32	14.44	85.98	24.20
South	70.28	35.27	69.57	50.65	60.14	33.78	96.00	33.66
West	85.40	40.51	160.63	88.05	58.90	24.29	63.26	32.33
Total	64.35	25.89	113.45	61.59	47.74	19.14	80.79	28.60
All buildings								
North	34.83	15.59	106.14	49.44	23.38	11.29	88.45	24.51
South	54.21	32.54	108.05	71.80	35.00	23.39	101.68	41.54
West	144.81	76.34	204.24	130.55	96.64	47.76	103.33	40.93
Total	60.52	29.78	164.93	97.73	34.08	17.68	96.08	32.17

Total Plywood Use

Amost 975 million square feet (3/8-inch basis) of plywood was used in nonresidential and nonhousekeeping building construction in 1969 (table 7, fig. 13).

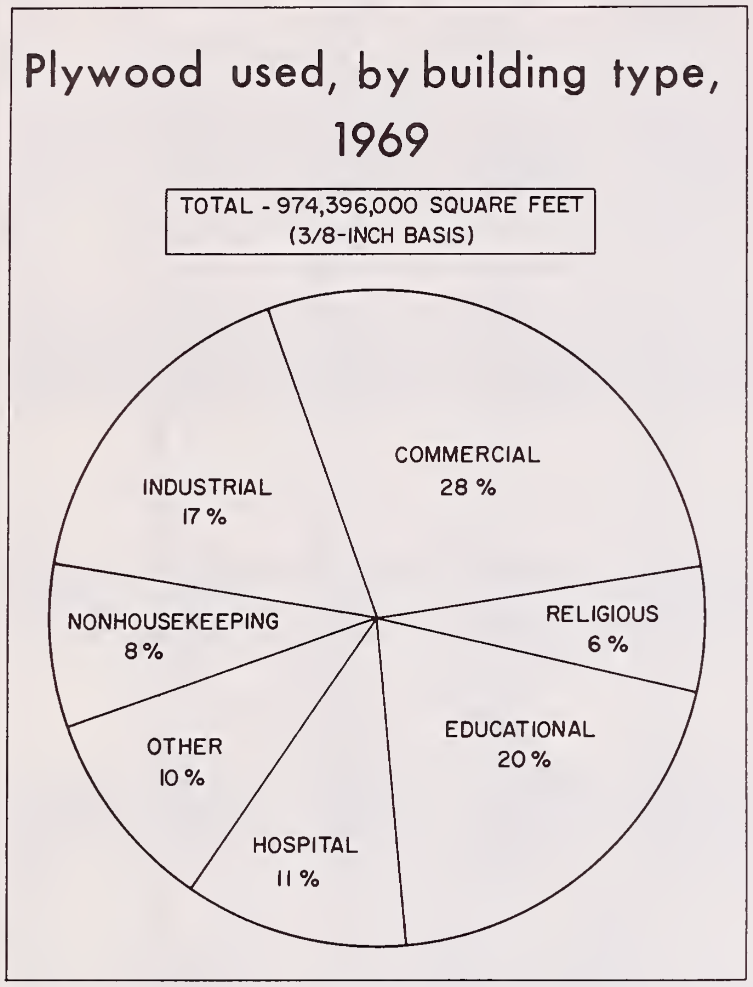

Figure 13

Two-thirds of the plywood was used in industrial, commercial, and educational buildings. These three building types accounted for about 75 percent of total floor area and total construction value. Approximately one-fifth of the plywood was used in hospital and other buildings; these buildings accounted for 14 percent of the floor area and 21 percent of the construction value. The remaining one-seventh of the plywood was used in constructing nonhousekeeping and religious buildings. These buildings, however, accounted for only 7 percent of the total floor area and total construction value.

The percentage of total plywood used by regions was very similar to that of lumber (fig. 14) with corresponding relationships between floor area and construction value.

Four-fifths of the total plywood used in building construction was fairly equally divided between wood and steel/masonry structural classes—38 percent and 41 percent, respectively. The wood class, however, accounted for little more than one-eighth of the floor area and construction value while the steel/masonry class accounted for nearly three-fourths of each. The concrete class accounted for the remaining one-fifth of the plywood used.

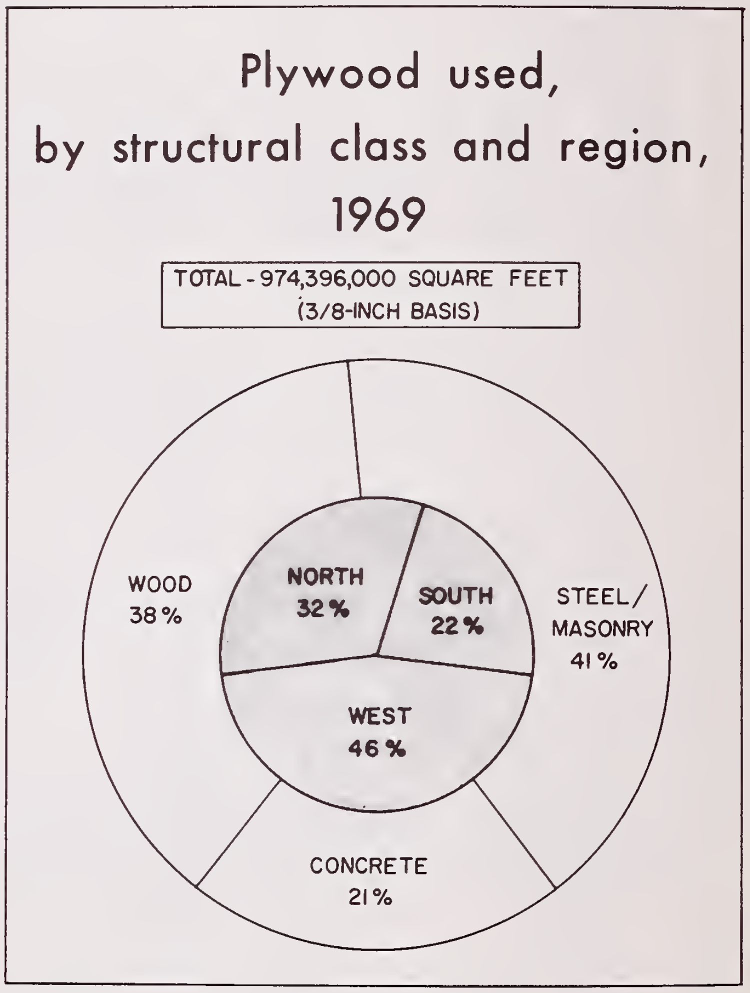

Figure 14

Table 7.-Plywood used in building construction in the United States, by building type, region, and structural class, 1969

Building type and region	All classes		Structural class		
			Wood	Steel/masonry	Concrete
	Thousand square feet 1/	Percent	Thousand square feet 1/	Thousand square feet 1/	Thousand square feet 1/
Nonhousekeeping					
North	40,472	49	8,625	10,480	21,367
South	15,525	19	3,521	3,159	8,845
West	25,877	32	20,099	4,077	1,701
Total	81,875	100	32,246	17,716	31,913
Industrial					
North	37,620	23	865	34,967	1,788
South	30,904	19	7,189	17,758	5,957
West	96,464	58	80,253	15,781	431
Total	164,989	100	88,308	68,505	8,176
Commercial					
North	50,356	19	11,099	32,813	6,443
South	38,670	14	7,764	23,310	7,597
West	178,811	67	95,748	62,712	20,352
Total	267,837	100	114,611	118,834	34,392
Religious					
North	27,039	47	20,931	5,624	484
South	17,562	31	13,749	2,832	981
West	12,334	22	10,406	544	1,384
Total	56,935	100	45,086	8,999	2,850
Educational					
North	80,332	41	1,457	61,422	17,453
South	49,288	25	3,557	30,757	14,975
West	67,487	34	31,687	27,925	7,875
Total	197,108	100	36,700	120,104	40,303
Hospital					
North	39,175	36	5,764	9,674	23,738
South	34,129	32	3,415	7,160	23,554
West	34,530	32	23,299	3,458	7,773
Total	107,835	100	32,478	20,292	55,065
Other					
North	42,355	43	6,228	23,804	12,322
South	26,385	27	3,448	13,999	8,939
West	29,078	30	13,399	7,881	7,798
Total	97,818	100	23,076	45,684	29,058
All buildings					
North	317,348	32	54,969	178,784	83,595
South	212,466	22	42,643	98,975	70,848
West	444,583	46	274,891	122,378	47,314
Total	974,397	100	372,503	400,137	201,757

1/ 3/8-inch basis

Note: Data may not add to totals because of rounding.

APPENDIX

DEFINITIONS

Building type[1]	
Nonhousekeeping	Buildings that provide residential facilities other than housing units and are generally characterized as nonhousekeeping quarters such as hotels (other than apartment hotels), motels, and dormitories.
Industrial	Buildings of manufacturing establishments, as defined in major groups 19-39 of the Standard Industrial Classification Manual, which are used to house production, assembly, and warehousing activities as well as auxiliary facilities such as administration buildings.
Commercial	Buildings that are primarily for the rental of office space, to house banks and other financial institutions, or for use in wholesale, retail, and service trades, such as stores, restaurants, and garages.
Educational	Buildings that are used directly in the administrative and instructional activities of establishments furnishing formal academic or technical courses. These establishments include colleges and universities, elementary and secondary schools, libraries, museums, and art galleries as well as laboratories which are not part of manufacturing establishments.
Religious	Buildings that are used primarily for religious services and functions or to house and train religious personnel; such as churches, synagogues, convents, monasteries, theological seminaries, etc., as well as funeral parlors, mausoleums, and crematories.
Hospital	Buildings for establishments which are primarily engaged in providing hospital and institutional care as general, mental, and tuberculosis hospitals, clinics or infirmaries, sanitariums, nursing homes, homes for the aged, orphanages, etc.
Other	Buildings, except farm and public utilities, which are not elsewhere classified such as auditoriums, theaters, indoor swimming pools, fire stations, bus and air passenger terminals, etc.
Structural class	
Wood	Buildings that used wood in one or more of the following structural areas: a. Wall framing consisting of wood studs or timbers. b. Floor framing consisting of wood joists or beams. c. Roof framing consisting of wood rafters, trusses, beams, or decking.
Steel/masonry	Buildings whose structural framing consisted of steel columns, trusses and girders, or buildings whose exterior walls consisted of concrete block, brick, or precast concrete, and whose floor and roof supports consisted of materials other than wood.

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[1] U.S. Bureau of Census, Construction Reports–Series C30-70, Value of new construction put in place; 1958-1970.

Concrete	Buildings whose structural framing consisted of reinforced concrete poured in place and whose floor or roof supports consisted of materials other than wood.
Other	
Floor area	Measurements were taken to the outside of the exterior walls and include all enclosed, usable floor space.
Construction value	Includes cost of construction materials installed, labor, contractor's profit, architect's and engineer's fees, and building site preparation.
Value of construction put in place	A measure of the value of construction installed or erected at the site during given period. It includes new construction, additions, and alterations.

SURVEY PROCEDURE

This survey procedure may be divided in two categories: (1) measurement of construction activity, and (2) measurement of wood use.

Measurement of Construction Activity

In order to stratify construction activity in the United States, a sample of 6,400 building projects was selected from 54,000 projects for which contracts for construction were awarded during the period of March 1, 1969, through August 30, 1969. The sample projects were selected on the basis that the probability of selection was proportional to size, as measured by contract award value. F. W. Dodge Division provided Dodge Construction Reports for each of the 6,400 projects selected. Based on information contained in the reports, projects were classified into three structural classes. (1) wood, (2) steel/masonry, and (3) concrete. This information and other pertinent data concerning the project such as building type, location, floor area, and contract award value were entered on punch cards to facilitate data processing.

The 54,000 building projects were stratified by seven building types and three regions in order to determine percentages of contract award value. These percentages were used as indicators of construction activity and applied to Bureau of Census estimates of new construction put-in-place, thereby providing an estimate of the value of new construction put in place by building type and region.

Measurements were taken from the plans relating to lumber and plywood use and converted to standard units of measure, i.e., board feet and square feet (3/8-inch basis). Regression equations were developed in the form $Y = A \times X^B$, where Y equals amount of wood use, X equals size of project in floor area or construction value, A equals a constant factor, and B equals a constant exponent. Regression equations relating construction cost and floor area to lumber and plywood use were calculated for each building type, region, and structural class. These equations were then applied to the 6,400 projects for which contracts for construction were awarded and which had been stratified by building type, region, and structural class. Wood use per $1,000 of construction and per 100 square feet of floor area were calculated for each stratum (tables 4 and 6) and applied to floor area (table 1) and construction value (table 2) resulting in total lumber and plywood use (tables 5 and 7).

The 6,400 building projects were stratified by building type, region, and structural class in order to determine the percentages of floor area and constract award value by the three categories. The contract award value percentages were used as construction activity indicators and applied to the regional value of new construction put in place to develop estimates of new construction put in place by structural class.

Measurement of Wood Use

Wood usage was determined by material takeoff from the plans and specifications of 842 building projects, and by contacting the building contractors for the project to determine the amount of wood required for the forming of concrete.

The sample of 842 building projects was selected from 5,400 projects reported in the Scan-Scope Weekly Bulletin during the period from July 1, 1968, to December 31, 1968. The projects were arrayed by building type, region, and value, and the sample of 842 projects selected with the probability of selection proportional to value. Microfilms of architectural plans and specifications were obtained for each of the sample projects.

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1974. **Lumber and plywood used in the construction of nonresidential and nonhousekeeping buildings in the United States, by regions, 1969.** USDA, Forest Service, Division of Forest Economics and Marketing Research, Washington, D.C., Research Paper WO-24, 17 pp.

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The building projects on which this study was based were classified into seven building types and three structural classes, and the amounts of lumber and plywood used were determined for three regions—North, South, and West.

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